National Aeronautics and Space Administration

The Inner AU of Proto-Planetary Disks

Rafael Millan-Gabet (Michelson Science Center) and Collaborators

Project Objective

We use ground based infrared long baseline interferometry to spatially resolve the innermost regions (<1AU to few AU) of circumstellar disks around young stars.

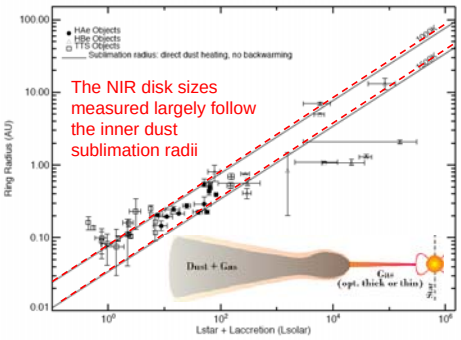
These new observables help elucidate the physical conditions in the terrestrial zones of planet-forming disks.

Recent Results

- Measured the near-IR sizes of disks around of a large sample of stars across the mass range. These sizes correspond to the location of the inner dust edge, shown to be primarily set by the dust destruction process.
- These observations have motivated a new generation of models for the inner disk (*see Dullemond, Dominik & Natta 2001; and later refinements*).
- Probed higher order inner disk morphology, via **(1)** the first NIR Closure Phase measurements, and **(2)** the use of very long (>300m) interferometric baselines. □

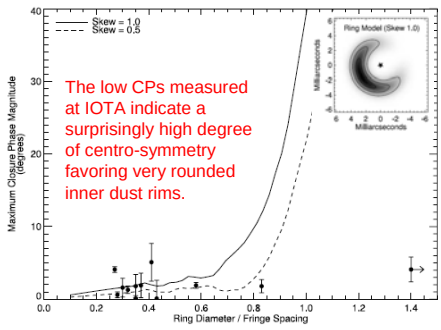
Following the first measurements made at the Infrared Optical Telescope Array (IOTA) and Palomar Testbed Interferometer (PTI), the **Keck Interferometer (KI)** established a Lstar - NIR disk size relation; which played a crucial role in motivating a new class of models for the inner dust disk. Remaining scatter in the relation is being actively investigated, by considering additional processes such as scattering & inner gas emission.

See the review by Millan-Gabet, Malbet, Akeson et al. 2007 in Protostars & Planets V.



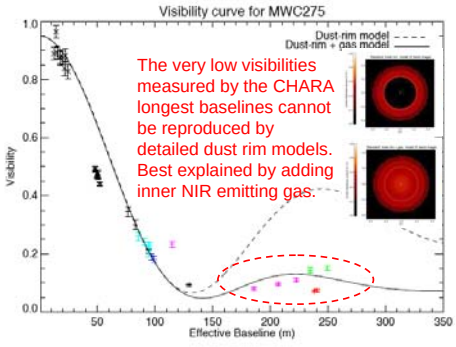
With **Closure Phases** (familiar to radio interferometry but new in the optical) the morphology of the inner disk can be further probed. The first CP survey, conducted at the **IOTA**, revealed surprisingly low values for most objects, indicating a high degree of centro-symmetry even for inclined disks, favoring models that produce a very "rounded" inner rim, rather than sharp edges.

Monnier, Millan-Gabet, Traub et al. 2005. Millan-Gabet, Monnier, Traub et al. 2006.



VERY long baselines (>300m), which highly resolve the disk, can also probe higher order inner disk morphology. Using this technique at the **Center for High Angular Resolution Array (CHARA)** we have inferred the presence of gas emitting a significant fraction of the NIR flux located inside the dust destruction radius.

Tannirkulam, Monnier, Millan-Gabet et al. 2008, ApJ, in press.



Significance of Results

Long baseline interferometry at near and mid-IR wavelengths is currently the only technique capable of resolving the AU-regions of pre-planetary disks. Groups making use of US and European facilities (KI, VLTI) have also used spectrally resolved interferometry to detect **hot inner gas** (Brγ, H2O, CO) and radial **dust mineralogy** gradients. Together with state-of-the-art physical disk models, and complementary spectroscopic observations, these new measurements are greatly advancing our understanding of pre-planetary environments, i.e. the **initial conditions for planet formation**.